

# A/B testing for marketing

ANALYZING MARKETING CAMPAIGNS WITH PANDAS



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# What is A/B testing?

*Prior to running the test determine:*

- What is the desired outcome of the test? What is our hypothesis?
- What is the metric we are trying to impact (i.e., page views, conversions)?
- Will we get enough traffic to our site to reach statistical significance and make a decision in a timely manner?

# Testing allows us to understand marketing impact



# How long does a test need to run?



# Personalized email test

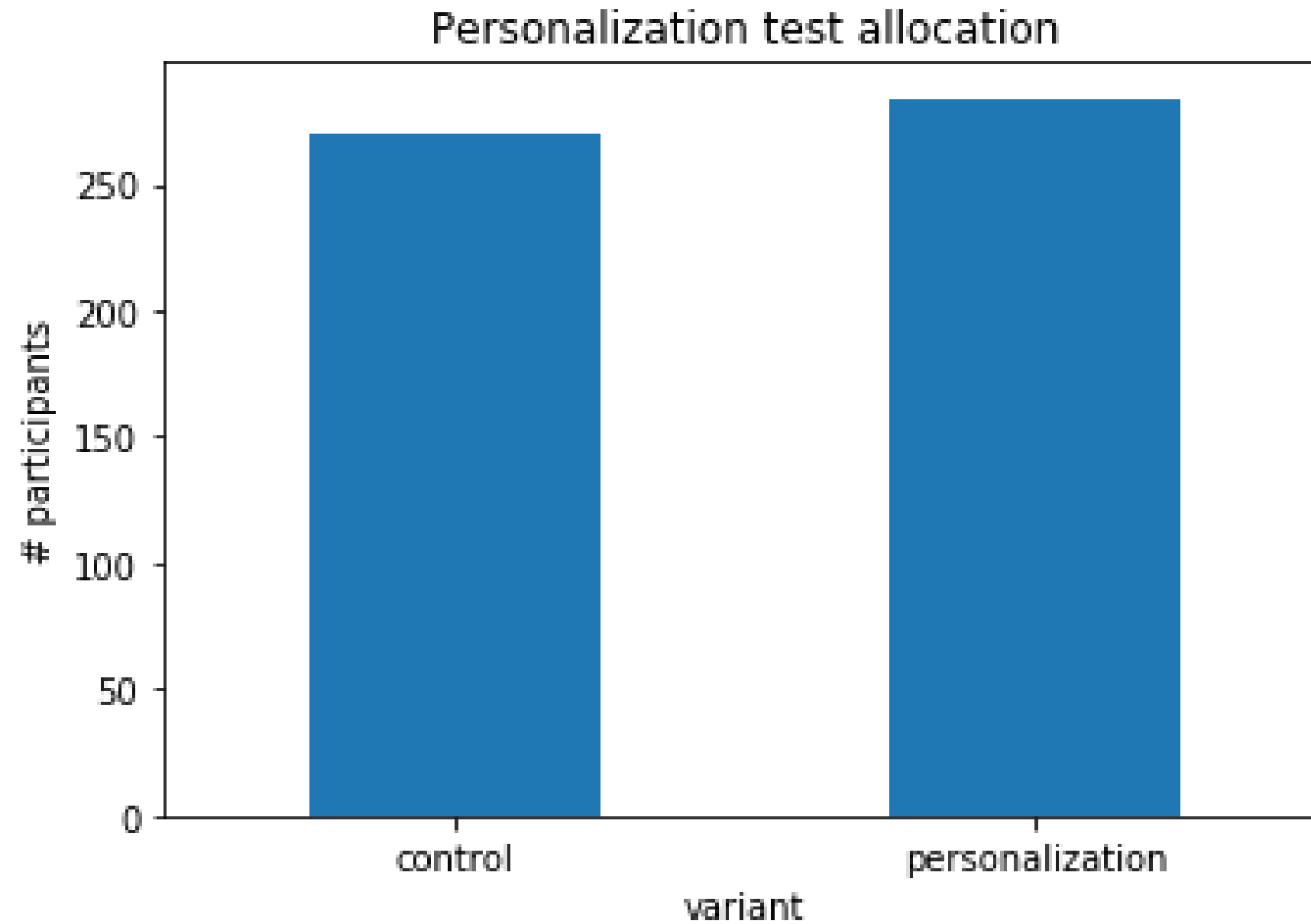


# Test allocation

```
email = marketing[marketing['marketing_channel'] == 'Email']
allocation = email.groupby(['variant'])\
                ['user_id'].nunique()

allocation.plot(kind='bar')
plt.title('Personalization test allocation')
plt.xticks(rotation = 0)
plt.ylabel('# participants')
plt.show()
```

# Allocation plot



# Setting up our data to evaluate the test

```
# Group by user_id and variant
subscribers = email.groupby(['user_id',
                             'variant'])['converted'].max()

subscribers = pd.DataFrame(subscribers.unstack(level=1))
```



# Setting up our data to evaluate the test

```
# Drop missing values from the control column
control = subscribers['control'].dropna()

# Drop missing values from the personalization column
personalization = subscribers['personalization'].dropna()
```

# Conversion rates

```
print("Control conversion rate:",  
      np.mean(control))  
print("Personalization conversion rate:",  
      np.mean(personalization))
```

```
Control conversion rate: 0.2814814814814815  
Personalization conversion rate: 0.3908450704225352
```

# Let's get testing!

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# Calculating lift & significance testing

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# Treatment performance compared to the control



## Calculating lift:

$$\frac{\text{Treatment conversion rate} - \text{Control conversion rate}}{\text{Control conversion rate}}$$

# Calculating lift

```
# Calculate the mean of a and b
a_mean = np.mean(control)
b_mean = np.mean(personalization)

# Calculate the lift using a_mean and b_mean
lift = (b_mean-a_mean)/a_mean

print("Lift:", str(round(lift*100, 2)) + '%')
```

```
Lift: 194.23%
```

# T-distribution

overlapping t distributions

<sup>1</sup> Identification of Timed Behavior Models for Diagnosis in Production Systems.  
Scientific Figure on ResearchGate.

# P-values

- T-statistic of 1.96 is typically statistically significant at the 95% level
- Depending on the context of the test, you may be comfortable with a lower or higher level of statistical significance.



# T-test in Python

```
from scipy.stats import ttest_ind

t = ttest_ind(control, personalized)

print(t)
```

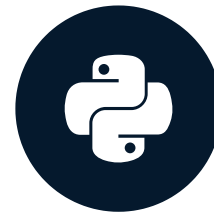
```
Ttest_indResult(statistic=-2.7343299447505074,  
                 pvalue=0.006451487844694175)
```

# Let's practice!

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# A/B testing & segmentation

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# Don't forget about segmentation!



# Personalization test segmented by language

```
for language in np.unique(marketing['language_displayed'].values):  
    print(language)
```

# Isolate the relevant data

```
for language in np.unique(marketing['language_displayed'].values):  
    print(language)  
  
    language_data = marketing[(marketing['marketing_channel'] == 'Email') &  
                             (marketing['language_displayed'] == language)]
```

# Isolate subscribers

```
for language in np.unique(marketing['language_displayed'].values):  
    print(language)  
  
    language_data = marketing[(marketing['marketing_channel'] == 'Email') &  
                              (marketing['language_displayed'] == language)]  
  
    subscribers = language_data.groupby(['user_id', 'variant'])['converted']\  
                                .max()
```

# Isolate control and personalization

```
for language in np.unique(marketing['language_displayed'].values):  
    print(language)  
  
    language_data = marketing[(marketing['marketing_channel'] == 'Email') &  
                              (marketing['language_displayed'] == language)]  
  
    subscribers = language_data.groupby(['user_id', 'variant'])['converted']\  
                              .max()  
  
    subscribers = pd.DataFrame(subscribers.unstack(level=1))  
    control = subscribers['control'].dropna()  
    personalization = subscribers['personalization'].dropna()
```



# Full for loop

```
for language in np.unique(marketing['language_displayed'].values):
    print(language)

    language_data = marketing[(marketing['marketing_channel'] == 'Email') &
                              (marketing['language_displayed'] == language)]

    subscribers = language_data.groupby(['user_id', 'variant'])['converted']\
                              .max()

    subscribers = pd.DataFrame(subscribers.unstack(level=1))
    control = subscribers['control'].dropna()
    personalization = subscribers['personalization'].dropna()

    print('lift:', lift(control, personalization))
    print('t-statistic:', stats.ttest_ind(control, personalization), '\n\n')
```

# Results

Arabic

lift: 50.0%

t-statistic: Ttest\_indResult(statistic=-0.58, pvalue=0.58)

English

lift: 39.0%

t-statistic: Ttest\_indResult(statistic=-2.22, pvalue=0.03)

German

lift: -1.62%

t-statistic: Ttest\_indResult(statistic=0.19, pvalue=0.85)

Spanish

lift: 166.67%

t-statistic: Ttest\_indResult(statistic=-2.36, pvalue=0.04)

# Let's practice!

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# Wrap-up

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# Dataset

```
marketing = pd.read_csv('marketing.csv')
print(marketing.head())
```

```
   user_id  date_served  channel  variant  conv  \
0  a100000029  2018-01-01  House Ads  personalization  True
1  a100000030  2018-01-01  House Ads  personalization  True
2  a100000031  2018-01-01  House Ads  personalization  True
3  a100000032  2018-01-01  House Ads  personalization  True
4  a100000033  2018-01-01  House Ads  personalization  True
```

```
   language_displayed  language_preferred  age_group
0          English          English  0-18 years
1          English          English  19-24 years
2          English          English  24-30 years
3          English          English  30-36 years
```

# Preprocessing

- Feature engineering
- Resolving errors in the data

# Marketing metrics

$$\text{Conversion rate} = \frac{\text{Number of people who convert}}{\text{Total number of people who we market to}}$$

$$\text{Retention rate} = \frac{\text{Number of people who remain subscribed}}{\text{Total number of people who converted}}$$

# Customer segmentation

```
marketing.groupby(['channel', 'age_group'])\  
            ['user_id'].count()
```



# Dip in conversion rate?

```
house_ads = marketing[marketing['channel'] == 'House Ads']  
  
language = conversion_rate(house_ads,  
                           ['date_served',  
                           'language_displayed'])
```

# You analyzed an A/B test

- Lift
- T-tests

# Good luck!

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